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C. Control and Signal Modules

VK2—Discrete Signal Module

1. Product Overview

The discrete control/signal modules are required to provide a means for the customer to communicate with and control the Tool Changer.

When the Tool Changer is coupled, the Master and Tool modules communicate across their interface using a spring loaded pin block. A flexible boot surrounds the pin block to seal the connection from moisture and liquid while coupled.

1.1 Master Module

(4) M12, 5-Pin connectors are provided on the control/signal Master module for customer interface to downstream I/O. The M12 connector wiring is compatible with that of an off-the-shelf IO-Link master block that is supplied by the user.

Integrated Locked, Unlocked and Ready-to-Lock proximity sensor input connections are provided for confirmation of Tool Changer and locking mechanism positions.

(3) Separate M12, 5-Pin connectors on the Master module support an interface to Tool Changer Locked, Unlocked and RTL proximity sensor inputs as well as Latch and Unlatch valve outputs. Cables are not provided in the overall Tool Changer package to connect these signals to the IO-Link master block. This interface allows for confirmation and control of the Tool Changer and locking mechanism position. Please refer to [Section 8—Drawings](#) for details.

An interface is also provided on the master module for support of a single or double integrated solenoid valve (DC Voltage). The integrated valve can is supplied as part of the valve adapter block, 9121-Jxx-M. Refer to the valve adapter block manual for more information (9620-20-C-Air and Valve Adapters).

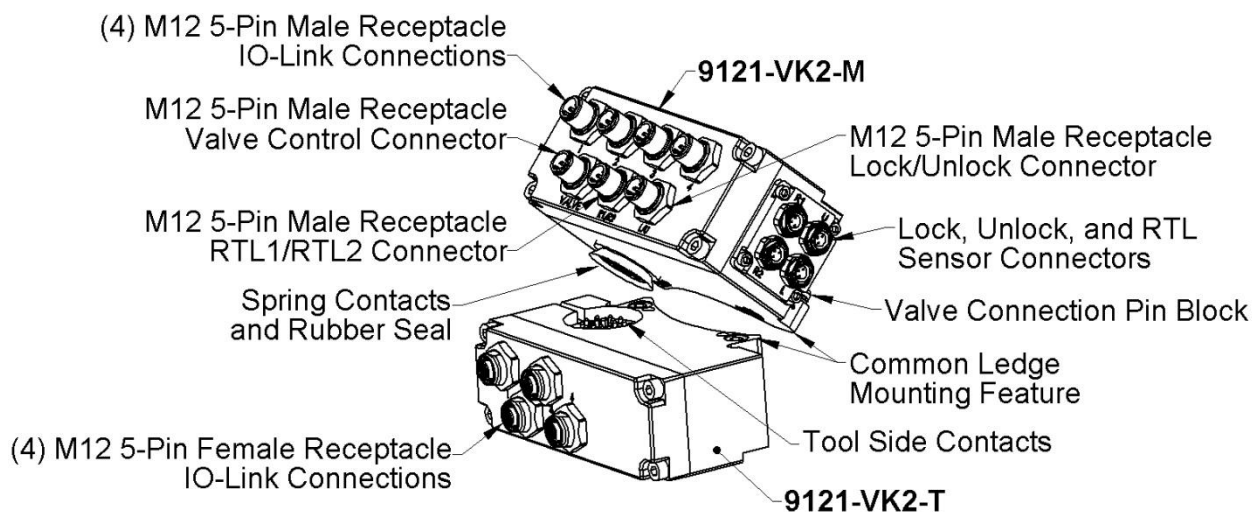
Refer to the specific Tool Changer manual for details on the operation of RTL, Lock and Unlock sensors

1.2 Tool Module

On the Tool module (4) separate M12 female, 5-Pin IO-Link connectors are provided to support and interface with customer tooling.

Refer to [Section 7—Specifications](#) and [Section 8—Drawings](#) for specific details.

Figure 1.1—VK2 Modules



2. Installation

The VK2 Modules are typically installed by ATI prior to shipment. The steps below outline the field installation or removal as required.

For wiring information refer to [Section 8—Drawings](#).

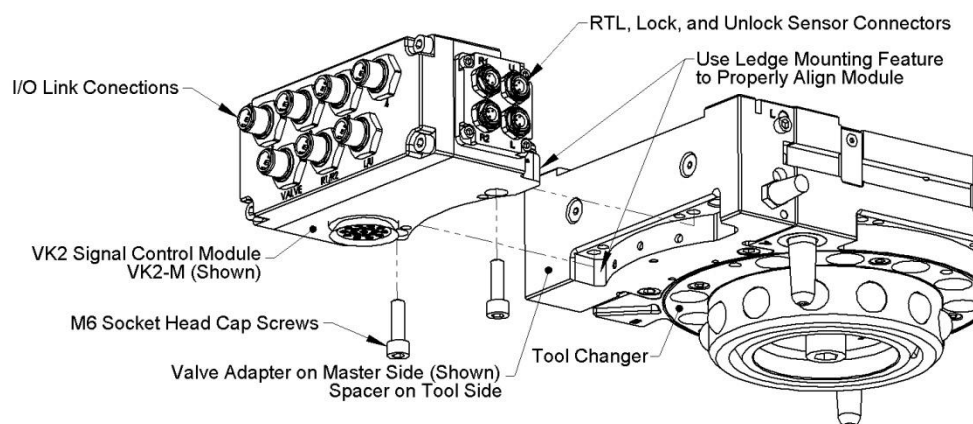


WARNING: Do not perform maintenance or repair on Tool Changer or modules unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on Tool Changer or

2.1 Installing

1. It may be necessary to clean the mounting surface on the Valve Adapter or spacer prior to installing the module in order to remove any debris that may be present.
2. Using the ledge feature as a guide place the module into the appropriate location on the Valve Adapter or spacer. Align the module with the Valve Adapter or spacer using the dowels in the bottom of the ledge feature. Refer to [Figure 2.1](#).
3. If fasteners do not have pre-applied adhesive, apply Loctite 242[®] to the supplied M6 SHCS fasteners. Install the two (2) M6 socket head screws securing the module to the Valve Adapter and tighten to 40–70 in-lbs.
4. Power, signal, auxiliary, sensor, and valve cables can be connected to the module after attaching the module to the Tool Changer body. Ensure that the connectors are cleaned prior to being secured as appropriate.

Figure 2.1—Module Installation



2.2 Removal

1. Prior to removing the module use a marker pen to scribe a line or indication between the Tool Changer and module body as a reminder where the module is to be re-installed.
2. Depending upon the service or repair being done, customer connections up to the module may or may not need to be disconnected.
3. Remove the socket head cap screws and lift the module from the Tool Changer. Refer to [Figure 2.1](#).



CAUTION: It is recommended, not to use fasteners with pre-applied adhesive more than three times. Fasteners used more than three times may come loose and cause equipment damage. Discard fasteners used more than three times and install new fasteners with pre-applied adhesive.

3. Operation

The VK2 Discrete Signal module is designed to provide four IO-Link pass through connections to the end-of-arm tooling. The Master module provides three integrated connections, two connections for the Lock/Unlock and Ready-to-Lock sensors and a Latch/Unlatch valve connection. The Locked, Unlocked and Ready-to-Lock proximity sensor input connections are provided for confirmation of Tool Changer and locking mechanism positions. Please refer to [Section 8—Drawings](#) for details.

Refer to the specific Tool Changer manual for details on the operation of the Tool Changer and recommended procedure for coupling.

When the Tool Changer is coupled, the discrete module tool can be communicated with, downstream I/O can be read and attached end-effectors can be used.

3.1 Recommended Sequence of Operation

This recommended Sequence of Operations procedure is to be used as a general guide when programming a robot or PLC for use with a Tool Changer and VK2 control/signal modules. This procedure is intended for "automatic" modes used during normal application processes

1. **Start**→ The robot and Tool Changer Master are free of the stand or storage location, the Tool Changer is uncoupled and the Tool Changer locking mechanism may be fully retracted (unlocked condition) or fully extended (missed Tool condition, i.e., **Locked** and **Unlocked** inputs are false). The Tool is by itself in the Tool Stand.
 - a. The **RTL** inputs (RTL1 and RTL2) are false.
 - b. The ATI Tool and any downstream device is offline.
2. Unlock the Master. (This must be done prior to the Master entering the Tool to prevent the ball bearings from impinging on the Tool bearing race.)
 - a. Provide air to the Unlock air port on the Master module.



CAUTION: Do not remove the air supply during operation. If air supply is not maintained during operation, damage to contacts and equipment can occur. The air supply must be maintained during operation.

- b. The **Unlocked** input goes true and remains true, indicating that the Tool Changer locking mechanism is fully retracted and the **Unlatch** operation is complete.
3. Robot and Master move into the Tool, are parallel and within 0.15" to 0.06" of the Tool (i.e., the module contact pins are touching, but the **RTL** sensors have not yet sensed the targets on the Tool).
 - a. Power and I/O connections with downstream devices are established.
4. Robot and Master move within 0.06" of the Tool.
 - a. The **RTL** inputs are true, indicating that it is okay to couple the Tool.
5. Couple the Tool Changer.
 - a. Provide air to the Lock air port on the Master module.



CAUTION: Do not remove the air supply during operation. If air supply is not maintained during operation, damage to contacts and equipment can occur. The air supply must be maintained during operation.

- b. The **Unlocked** input goes false a short time later, indicating piston travel. Subsequently, the **Locked** input goes true and remains true, indicating that the coupling operation is complete.
6. Robot moves away from the Tool Stand with the Tool Changer coupled.

7. Normal operation
 - a. The following inputs are true:
 - i. **Locked**
 - ii. **RTL**
 - b. The following inputs are false:
 - i. **Unlocked**
8. Robot moves into the Tool Stand with the Tool Changer coupled.
9. Uncouple the Tool Changer. **IMPORTANT:** It is critical that the tool be nested securely in the Tool Stand prior to Uncoupling the Tool Changer.
 - a. Provide air to the Unlock air port on the Master module.



CAUTION: Do not remove the air supply during operation. If air supply is not maintained during operation, damage to contacts and equipment can occur. The air supply must be maintained during operation.

- b. The **Locked** input goes false a short time later and subsequently the **Unlocked** input goes true and remains true, indicating that the uncoupling operation is complete.
10. Robot and Master move away from the Tool, are parallel and between 0.15" to 0.06" of the Tool.
 - a. The **RTL** inputs are false.
11. Robot and Master move away from the Tool, are parallel and > 0.15" from the Tool.
 - a. Power and I/O connections with downstream devices are no longer available.
12. Robot and Master in free space.
 - a. The following inputs are true:
 - i. **Unlocked**
 - b. The following inputs are false:
 - i. **Locked**
 - ii. **RTL**

4. Maintenance

Once installed the operation of the control modules is generally trouble free. The modules are not designed to be field serviced as all point-to-point wiring connections are soldered. Component replacement is limited to the V-Ring seal on the Master.



WARNING: Do not perform maintenance or repair on Tool Changer or modules unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on Tool Changer or modules.

If the Tool Changer is being used in dirty environments (e.g., welding or deburring applications), care should be taken to limit the exposure of the Tool Changer. Idle Tool assemblies should be covered to prevent debris from settling on the mating surface. Also, the Master assembly should be exposed for only a short period of time during Tool change and down time.

Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred. Perform the following visual inspection monthly:

- Inspect mounting fasteners to verify they are tight and if loose, then tighten to the proper torque.
- Cable connections should be inspected during maintenance periods to ensure they are secure. Loose connections should be cleaned and re-tightened as appropriate. Inspect cable sheathing for damage, repair or replace damaged cabling. Loose connections or damaged cabling are not expected and may indicate improper routing and/or strain relieving.

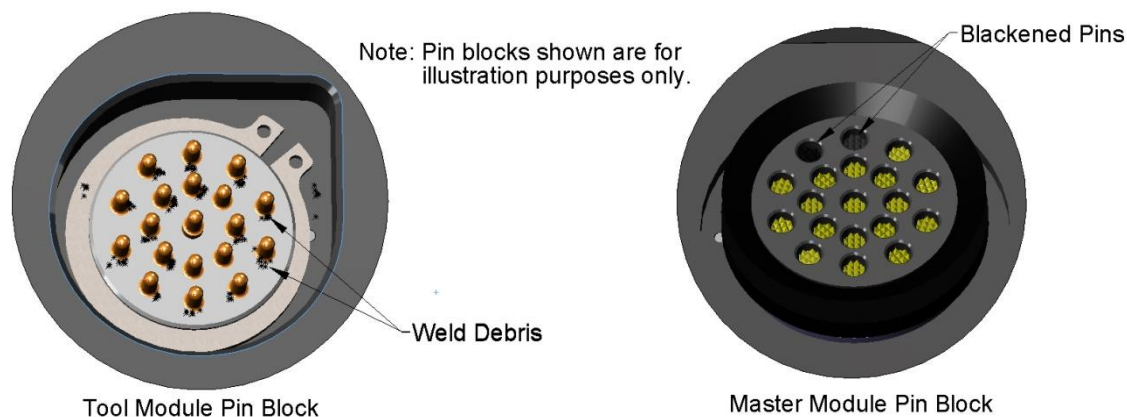
Inspect the Master and Tool pin blocks for any pin damage, debris or darkened pins. Refer to [Section 4.1—Pin Block Inspection and cleaning](#).

Inspect V-Ring seals for wear, abrasion, and cuts. If worn or damaged, replace. Refer to [Section 4.2—Seal Replacement](#).

4.1 Pin Block Inspection and cleaning

Inspect the Master and Tool pin blocks for any debris or darkened pins.

Figure 4.1—Inspect Master and Tool Pin Blocks

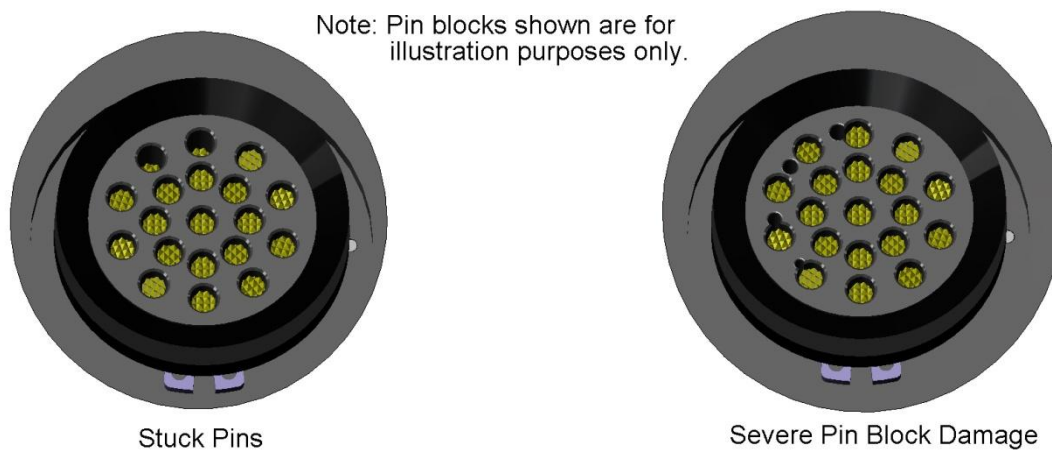


If debris or darkened pins exist, remove debris using a vacuum, and clean using a nylon brush (ATI part number 3690-0000064-60).

NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause erosion to the contact surface. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number 3690-0000064-60).

Inspect the Master and Tool pin blocks for stuck pins or severe pin block damage.

Figure 4.2—Stuck Pin and Pin Block Damage



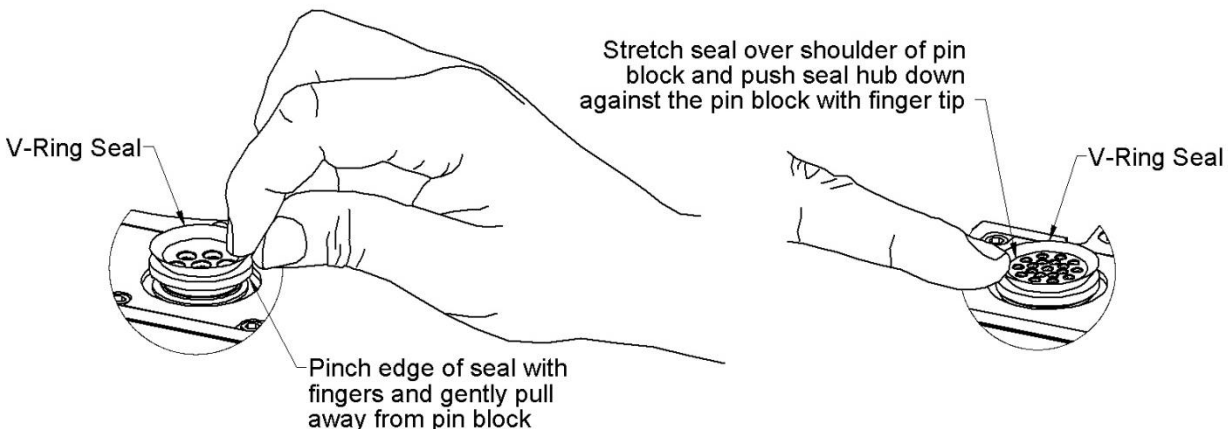
If stuck pins or severe pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.

4.2 Seal Replacement

Replace the V-Ring seal:

1. To remove the existing seal, pinch edge of seal with fingers and gently pull the seal away from the pin block on the Master.
2. Pull the seal off the pin block.
3. To install a new seal, stretch the new seal over the shoulder of the pin block.
4. Push the seal's hub down against the pin block using finger tip.

Figure 4.3—V-Ring seal Replacement



5. Troubleshooting

Symptom	Possible Cause	Correction
Unit will not lock or unlock	Verify that ball bearings are moving freely. Clean and lubricate as needed.	Verify that ball bearings are moving freely. Clean and lubricate as needed. <i>Refer to the Maintenance section of the Tool Changer manual for instructions.</i>
	Air supply not to specifications.	Check air supply. <i>Refer to the Installation section of the Tool Changer manual for specifications.</i>
	Check that exhaust port is properly vented (check muffler).	Check that exhaust port is properly vented (check muffler). <i>Refer to Air and Valve adapter section for information.</i>
	Incorrect valve operation.	Check valve for proper operation. <i>Refer to Air and Valve adapter section for information.</i>
	Discrete signals are mapped incorrectly.	Verify that discrete signals are mapped and are communicating properly. <i>Refer to Section 8—Drawings for electrical schematic.</i>
	Master and Tool are within the specified No-Touch zone.	Verify that the Master and Tool are within the specified No-Touch zone when attempting to lock. <i>Refer to the Installation – Tool Stand Design Section of the Tool Change manual for specifications.</i>
	Air trapped in the Unlock (U) air port.	Ensure that there is no air trapped in the Unlock (U) air port. <i>Refer to Air and Valve adapter section for pneumatic specification and requirements.</i>
Sensors not operating properly	Sensor cables damage or incorrectly connected.	Verify that cables are connected correctly and not damaged, replace if damaged. <i>Refer to the Troubleshooting Section of the Tool Change manual.</i>
	Sensors are set incorrectly.	Verify that the sensors are set correctly. <i>Refer to the Troubleshooting Section of the Tool Change manual.</i>
	Tool Plate is not secured properly or debris is trapped between surfaces.	Ensure that the Tool Plate is securely held to the Master Plate, that nothing is trapped between their surfaces.
Loss of Communication	Damaged signal cabling	Check/Replace signal cabling up- and down-stream of Tool Changer modules.
	Worn or damaged contact pins	Inspect module contact pins for debris/wear/damage.

6. Recommended Spare Parts

See [Section 8—Drawings](#).

7. Specifications

9121-VK2-M	Discrete Module Supporting Integrated Solenoid Valve (DC Voltage), Tool Changer I/O and IO-Link master block. Mates with VK2 Tool.
Connector(s)	(7X) Turck FSFDL 4.5, M12 Male, 5-Pin Connectors: Supporting (4X) IO-Link connections and Valve Control, RTL1/RTL2, and Lock/Unlock connections. <u>Integrated Tool Changer I/O:</u> (4X) M8, 3-pin female connectors supporting Tool Changer Locked, Unlocked, and Ready-to-Lock proximity sensors, PNP sensor type.
Weight	1.73 lbs (0.79 kg)
Electrical Rating	<u>IO-Link Pass-Through:</u> 19 @ 3A, 24V, Via M12 Turck Connectors and ATI 19-Pin Block.
	<u>Tool Changer Control:</u> Lock, Unlock, and Ready-to-Lock sensors: 10-30 VDC operational voltage (Sensors are PNP, sourcing-type).
	<u>Valve Control Power:</u> Latch and Unlatch Valve control: 19-29 VDC operational voltage.

9121-VK2-T	Discrete Module Supporting IO-Link Block on Tool. Mates with VK2-M.
Connector(s)	(4X) Turck FKFDLV 57, M12 Female, 5-Pin Connectors: Supporting I/O Link Connections.
Weight	1.24 lbs (0.56 kg)
Electrical Rating	<u>I/O Pass-Through:</u> 19 @ 3A, 24V, Via M12 Turck Connectors and ATI 19-Pin Block.

8. Drawings

